



An innovative EIS based 3D printed conductometer

Canali, Chiara; Heiskanen, Arto; Muhammad, Haseena Bashir; Dufva, Martin; Emnéus, Jenny

Published in:

Proceedings of the 15th International Conference on Electroanalysis

Publication date:

2014

[Link back to DTU Orbit](#)

Citation (APA):

Canali, C., Heiskanen, A., Muhammad, H. B., Dufva, M., & Emnéus, J. (2014). An innovative EIS based 3D printed conductometer. In *Proceedings of the 15th International Conference on Electroanalysis*

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

An innovative EIS based 3D printed conductometer

Chiara Canali, Arto Heiskanen, Haseena Bashir Muhammad, Martin Dufva and Jenny Emnéus*

chca@nanotech.dtu.dk

*Department of Micro- and Nanotechnology, Technical University of Denmark, Kongens Lyngby, Denmark

Electrical conductivity (σ) is a measure of the ability of a material to carry a current. Testing for σ is particularly significant when defining physico-chemical properties of electrolytes since it is related to ionic strength, mobility and valence, and is sensitive to shift in temperature, CO₂ content, and therefore pH. For this reason, σ and its variation over time convey a high degree of information, not only about inorganic and organic solutions, but more importantly about dynamics of biological processes.

The simplest approach to determine σ is by applying an alternating electric field between two electrodes and measuring the impedance value at the frequency for which phase angle value is equal to 0°. Modern instruments automatically adapt the frequency of analysis to the particular measuring conditions¹.

Here, an electrochemical impedance spectroscopy (EIS) based conductometer is presented as a sensitive, low cost instrument able to correlate the whole impedance spectrum to the σ value of solutions. The device can be easily 3D printed in acrylonitrile butadiene styrene (ABS) and incorporates two rectangular gold plate electrodes (Fig. 1).

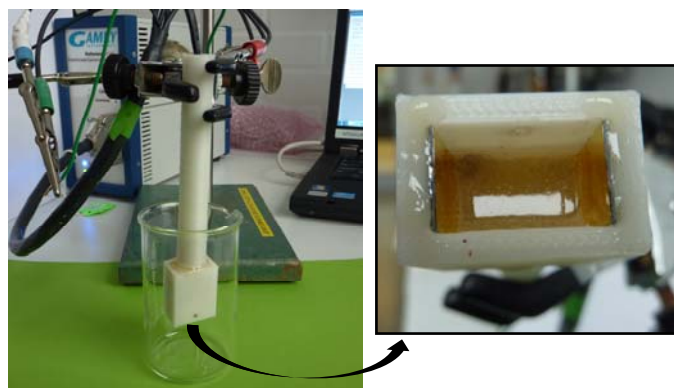


Figure 1: The EIS based conductometer interfaced with Reference 600 potentiostat (Gamry).

The cell constant of the measurement cell was determined to be $1.77 \pm 0.06 \text{ cm}^{-1}$ by EIS analysis on different σ standard solutions and then confirmed by geometrical measurements.

The device was tested by measuring σ of several dilutions of physiological phosphate buffered saline (PBS) solutions in the range 10^{-4} -10x exploiting both EIS and single frequency analysis. Reproducible results were obtained and validated against a commercial conductometer and literature search.

Taking together, all the results prove that the performance of the 3D printed conductometer described here is comparable to that of the commercial instrument and serves as an inexpensive and innovative alternative for quick evaluation of σ .

Reference:

1. "Conductivity. Theory and practice." Radiometer Analytical